

# SN54LS240, SN54LS241, SN54LS244, SN54S240, SN54S241, SN54S244, SN74LS240, SN74LS241, SN74LS244, SN74S240, SN74S241, SN74S244 OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS

APRIL 1985—REVISED MARCH 1988

- 3-State Outputs Drive Bus Lines or Buffer Memory Address Registers
- PNP Inputs Reduce D-C Loading
- Hysteresis at Inputs Improves Noise Margins

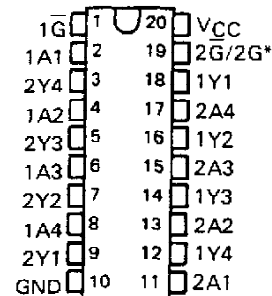
## description

These octal buffers and line drivers are designed specifically to improve both the performance and density of three-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters. The designer has a choice of selected combinations of inverting and noninverting outputs, symmetrical  $\bar{G}$  (active-low output control) inputs, and complementary  $G$  and  $\bar{G}$  inputs. These devices feature high fan-out, improved fan-in, and 400-mV noise-margin. The SN74LS' and SN74S' can be used to drive terminated lines down to 133 ohms.

The SN54' family is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74' family is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

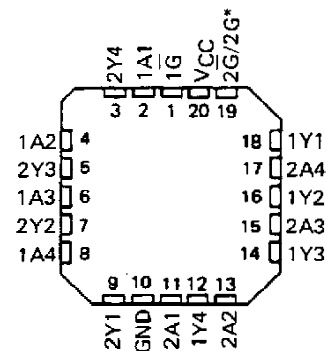
SN54LS', SN54S' ... J OR W PACKAGE  
SN74LS', SN74S' ... DW OR N PACKAGE

(TOP VIEW)



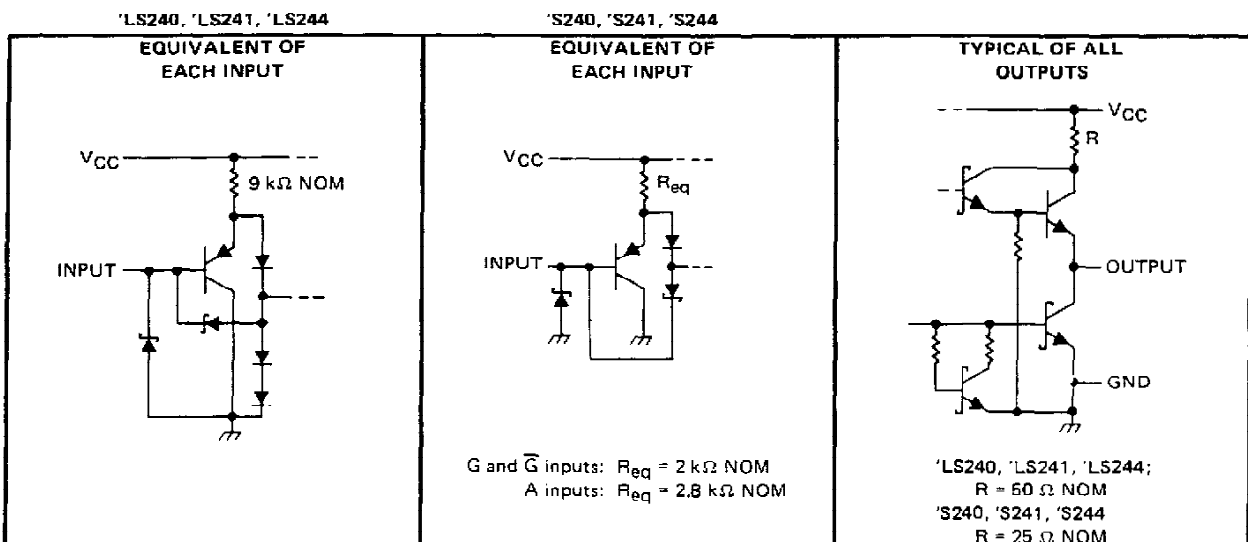
SN54LS', SN54S' ... FK PACKAGE

(TOP VIEW)



\*2G for 'LS241 and 'S241 or 2G for all other drivers.

## schematics of inputs and outputs



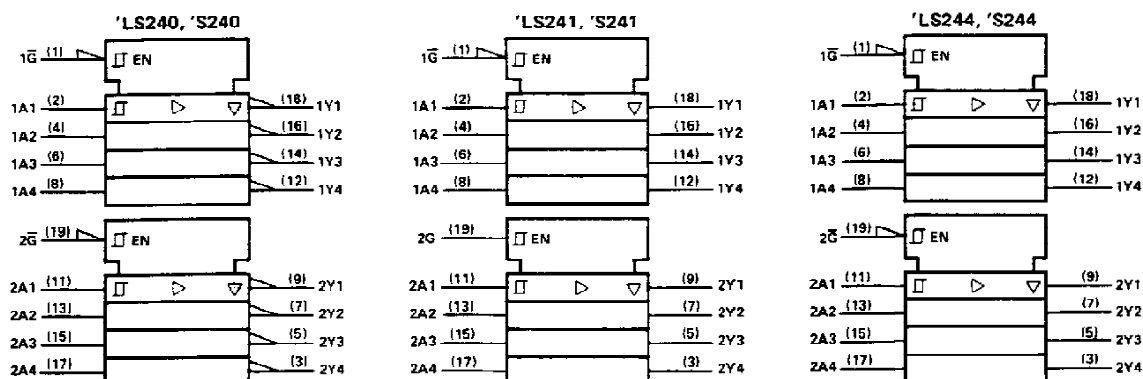
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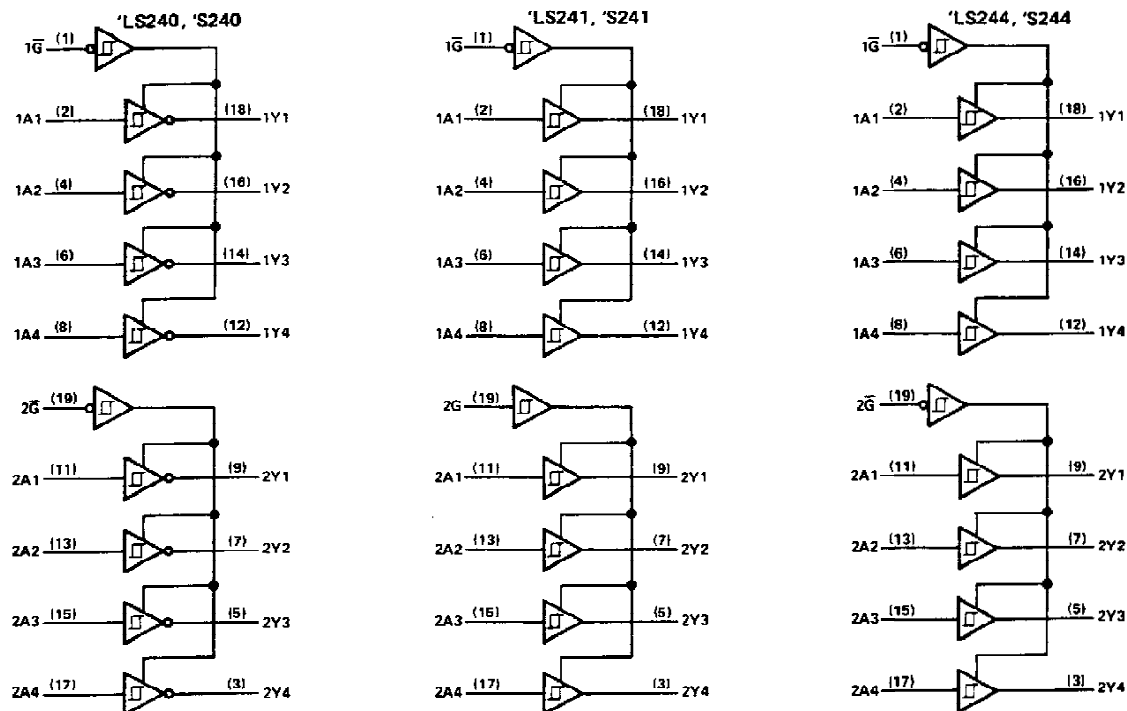
# **SN54LS240, SN54LS241, SN54LS244, SN54S240, SN54S241, SN54S244, SN74SL240, SN74LS241, SN74LS244, SN74S240, SN74S241, SN74S244** **OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS**

## **logic symbols†**



†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

## **logic diagrams (positive logic)**



Pin numbers shown are for DW, J, N, and W packages.

## **absolute maximum ratings over operating free-air temperature range (unless otherwise noted)**

|                                                                |                  |
|----------------------------------------------------------------|------------------|
| Supply voltage, $V_{CC}$ (see Note 1).                         | 7 V              |
| Input voltage: 'LS Circuits.                                   | 7 V              |
| 'S Circuits.                                                   | 5.5 V            |
| Off-state output voltage.                                      | 5.5 V            |
| Operating free-air temperature range: SN54LS', SN54S' Circuits | -55° C to 125° C |
| SN74LS', SN74S' Circuits                                       | 0° C to 70° C    |
| Storage temperature range                                      | -65° C to 150° C |

NOTE 1: Voltage values are with respect to network ground terminal.

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# SN54LS240, SN54LS241, SN54LS244, SN74LS240, SN74LS241, SN74LS244

## OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS

### recommended operating conditions

| PARAMETER                                     | SN54LS <sup>1</sup> |     |     | SN74LS <sup>1</sup> |     |      | UNIT |
|-----------------------------------------------|---------------------|-----|-----|---------------------|-----|------|------|
|                                               | MIN                 | NOM | MAX | MIN                 | NOM | MAX  |      |
| V <sub>CC</sub> Supply voltage (see Note 1)   | 4.5                 | 5   | 5.5 | 4.75                | 5   | 5.25 | V    |
| V <sub>IH</sub> High-level input voltage      | 2                   |     |     | 2                   |     |      | V    |
| V <sub>IL</sub> Low-level input voltage       |                     |     | 0.7 |                     |     | 0.8  | V    |
| I <sub>OH</sub> High-level output current     |                     |     | -12 |                     |     | -15  | mA   |
| I <sub>OL</sub> Low-level output current      |                     |     | 12  |                     |     | 24   | mA   |
| T <sub>A</sub> Operating free-air temperature | -55                 |     | 125 | 0                   |     | 70   | °C   |

NOTE 1: Voltage values are with respect to network ground terminal.

### electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER                                       | TEST CONDITIONS†                                                                             |                         | SN54LS <sup>1</sup> |      |      | SN74LS <sup>1</sup> |      |      | UNIT |
|-------------------------------------------------|----------------------------------------------------------------------------------------------|-------------------------|---------------------|------|------|---------------------|------|------|------|
|                                                 |                                                                                              |                         | MIN                 | TYP‡ | MAX  | MIN                 | TYP‡ | MAX  |      |
| V <sub>IK</sub>                                 | V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA                                               |                         |                     |      | -1.5 |                     |      | -1.5 | V    |
| Hysteresis (V <sub>T+</sub> - V <sub>T-</sub> ) | V <sub>CC</sub> = MIN                                                                        |                         | 0.2                 | 0.4  |      | 0.2                 | 0.4  |      | V    |
| V <sub>OH</sub>                                 | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX, I <sub>OH</sub> = -3 mA |                         | 2.4                 | 3.4  |      | 2.4                 | 3.4  |      | V    |
|                                                 | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.5 V, I <sub>OH</sub> = MAX |                         | 2                   |      |      | 2                   |      |      |      |
| V <sub>OL</sub>                                 | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX                          | I <sub>OL</sub> = 12 mA |                     |      | 0.4  |                     |      | 0.4  | V    |
|                                                 |                                                                                              | I <sub>OL</sub> = 24 mA |                     |      |      |                     |      | 0.5  |      |
| I <sub>OZH</sub>                                | V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX                          | V <sub>O</sub> = 2.7 V  |                     |      | 20   |                     |      | 20   | µA   |
| I <sub>OZL</sub>                                |                                                                                              | V <sub>O</sub> = 0.4 V  |                     |      | -20  |                     |      | -20  |      |
| I <sub>I</sub>                                  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V                                                  |                         |                     |      | 0.1  |                     |      | 0.1  | mA   |
| I <sub>IH</sub>                                 | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V                                                |                         |                     |      | 20   |                     |      | 20   | µA   |
| I <sub>IL</sub>                                 | V <sub>CC</sub> = MAX, V <sub>IL</sub> = 0.4 V                                               |                         |                     |      | -0.2 |                     |      | -0.2 | mA   |
| I <sub>OS</sub> §                               | V <sub>CC</sub> = MAX                                                                        |                         | -40                 |      | -225 | -40                 |      | -225 | mA   |
| I <sub>CC</sub>                                 | Outputs high                                                                                 | All                     |                     |      | 17   |                     |      | 17   | mA   |
|                                                 | Outputs low                                                                                  | 'LS240                  |                     |      | 26   |                     |      | 26   |      |
|                                                 |                                                                                              | 'LS241, 'LS244          |                     |      | 27   |                     |      | 27   |      |
|                                                 | All outputs disabled                                                                         | 'LS240                  |                     |      | 29   |                     |      | 29   |      |
|                                                 |                                                                                              | 'LS241, 'LS244          |                     |      | 32   |                     |      | 32   |      |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

### switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

| PARAMETER        | TEST CONDITIONS                                            |  | 'LS240 |     |     | 'LS241, 'LS244 |     |     | UNIT |
|------------------|------------------------------------------------------------|--|--------|-----|-----|----------------|-----|-----|------|
|                  |                                                            |  | MIN    | TYP | MAX | MIN            | TYP | MAX |      |
| t <sub>PLH</sub> | R <sub>L</sub> = 667 Ω, C <sub>L</sub> = 45 pF, See Note 2 |  |        | 9   | 14  |                | 12  | 18  | ns   |
| t <sub>PHL</sub> |                                                            |  |        | 12  | 18  |                | 12  | 18  | ns   |
| t <sub>PZL</sub> |                                                            |  |        | 20  | 30  |                | 20  | 30  | ns   |
| t <sub>PZH</sub> |                                                            |  |        | 15  | 23  |                | 15  | 23  | ns   |
| t <sub>PLZ</sub> | R <sub>L</sub> = 667 Ω, C <sub>L</sub> = 5 pF, See Note 2  |  |        | 10  | 20  |                | 10  | 20  | ns   |
| t <sub>PHZ</sub> |                                                            |  |        | 15  | 25  |                | 15  | 25  | ns   |

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

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# SN54S240, SN54S241, SN54S244, SN74S240, SN74S241, SN74S244, OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS

## recommended operating conditions

| PARAMETER                                                    | SN54S* |     |     | SN74S* |     |      | UNIT       |
|--------------------------------------------------------------|--------|-----|-----|--------|-----|------|------------|
|                                                              | MIN    | NOM | MAX | MIN    | NOM | MAX  |            |
| $V_{CC}$ Supply voltage, (see Note 1)                        | 4.5    | 5   | 5.5 | 4.75   | 5   | 5.25 | V          |
| $V_{IH}$ High-level input voltage                            | 2      |     |     | 2      |     |      | V          |
| $V_{IL}$ Low-level input voltage                             |        |     | 0.8 |        |     | 0.8  | V          |
| $I_{OH}$ High-level output current                           |        |     | -12 |        |     | -15  | mA         |
| $I_{OL}$ Low-level output current                            |        |     | 48  |        |     | 64   | mA         |
| External resistance between any input and $V_{CC}$ or ground |        |     | 40  |        |     | 40   | k $\Omega$ |
| $T_A$ Operating free-air temperature (see Note 3)            | -55    |     | 125 | 0      |     | 70   | °C         |

NOTES: 1. Voltage values are with respect to network ground terminal.

3. An SN54S241J operating at free-air temperature above 116°C requires a heat sink that provides a thermal resistance from case to free-air  $R_{\theta CA}$ , of not more than 40°C/W.

## electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER                                          |                  | TEST CONDITIONS†                                                                                |              | SN54S' |      | SN74S' |     | UNIT |
|----------------------------------------------------|------------------|-------------------------------------------------------------------------------------------------|--------------|--------|------|--------|-----|------|
|                                                    |                  |                                                                                                 |              | MIN    | TYP‡ | MAX    | MIN |      |
| V <sub>IK</sub>                                    |                  | V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA                                                  |              | -1.2   |      | -1.2   |     | V    |
| Hysteresis<br>(V <sub>T+</sub> - V <sub>T-</sub> ) |                  | V <sub>CC</sub> = MIN                                                                           |              | 0.2    | 0.4  | 0.2    | 0.4 | V    |
| V <sub>OH</sub>                                    |                  | V <sub>CC</sub> = MIN, I <sub>OH</sub> = -1 mA, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, |              |        | 2.7  |        | V   |      |
|                                                    |                  | V <sub>CC</sub> = MIN, I <sub>OH</sub> = -3 mA, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, | 2.4          | 3.4    | 2.4  | 3.4    |     |      |
|                                                    |                  | V <sub>CC</sub> = MIN, I <sub>OH</sub> = MAX, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.5 V,   | 2            | 2      |      |        |     |      |
| V <sub>OL</sub>                                    |                  | V <sub>CC</sub> = MIN, I <sub>OL</sub> = MAX, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V,   | 0.55         |        | 0.55 |        | V   |      |
| I <sub>OZH</sub>                                   |                  | V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2 V, V <sub>O</sub> = 2.4 V                            | 50           |        | 50   |        | μA  |      |
| I <sub>OZL</sub>                                   |                  | V <sub>CC</sub> = MAX, V <sub>IL</sub> = 0.8 V, V <sub>O</sub> = 0.5 V                          | -50          |        | -50  |        |     |      |
| I <sub>I</sub>                                     |                  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V                                                   | 1            |        | 1    |        | mA  |      |
| I <sub>IH</sub>                                    |                  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V                                                   | 50           |        | 50   |        | μA  |      |
| I <sub>IL</sub>                                    | Any A            | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.5 V                                                   | -400         |        | -400 |        | μA  |      |
|                                                    | Any G            |                                                                                                 | -2           |        | -2   |        | mA  |      |
| I <sub>OS</sub> §                                  |                  | V <sub>CC</sub> = MAX                                                                           | -50          | -225   | -50  | -225   | mA  |      |
| I <sub>CC</sub>                                    | Outputs high     | V <sub>CC</sub> = MAX, Outputs open                                                             | 'S240        | 80     | 123  | 80     | 135 | mA   |
|                                                    | 'S241, 'S244     |                                                                                                 | 95           | 147    | 95   | 160    |     |      |
|                                                    | Outputs low      |                                                                                                 | 'S240        | 100    | 145  | 100    | 150 |      |
|                                                    | 'S241, 'S244     |                                                                                                 | 120          | 170    | 120  | 180    |     |      |
|                                                    | Outputs disabled |                                                                                                 | 'S240        | 100    | 145  | 100    | 150 |      |
|                                                    |                  |                                                                                                 | 'S241, 'S244 |        | 120  | 170    | 120 |      |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.



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**SN54S240, SN54S241, SN54S244, SN74S240, SN74S241, SN74S244,  
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switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

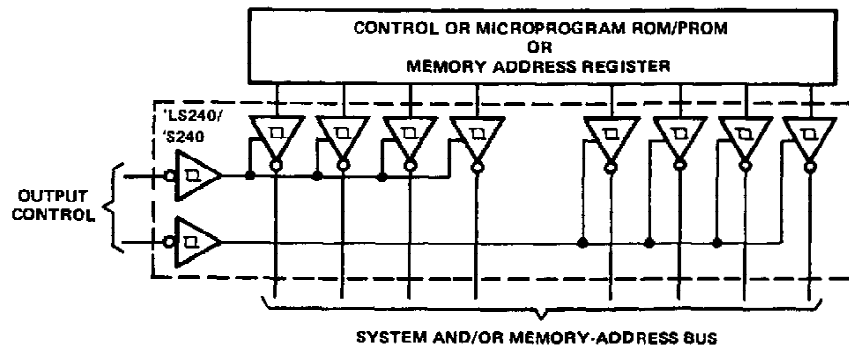
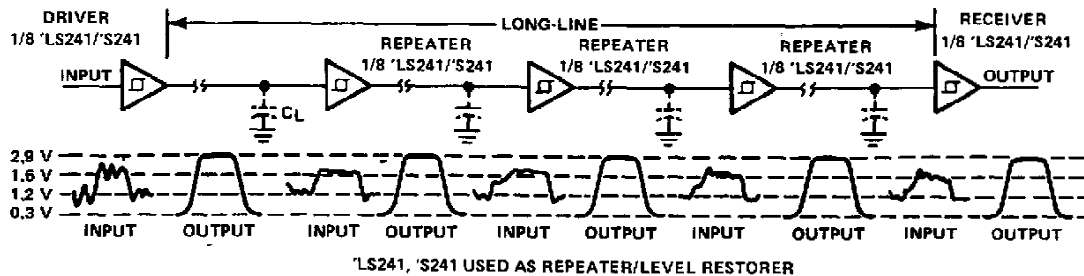
| PARAMETER | TEST CONDITIONS                                            | 'S240 |     |     | 'S241, 'S244 |     |     | UNIT |
|-----------|------------------------------------------------------------|-------|-----|-----|--------------|-----|-----|------|
|           |                                                            | MIN   | TYP | MAX | MIN          | TYP | MAX |      |
| $t_{PLH}$ | $R_L = 90\ \Omega$ ,<br>See Note 4<br>$C_L = 50\text{ pF}$ | 4.5   |     | 7   |              | 6   | 9   | ns   |
| $t_{PHL}$ |                                                            | 4.5   |     | 7   |              | 6   | 9   | ns   |
| $t_{PZL}$ |                                                            | 10    |     | 15  |              | 10  | 15  | ns   |
| $t_{PZH}$ |                                                            | 6.5   |     | 10  |              | 8   | 12  | ns   |
| $t_{PLZ}$ | $R_L = 90\ \Omega$ ,<br>See Note 4<br>$C_L = 5\text{ pF}$  | 10    |     | 15  |              | 10  | 15  | ns   |
| $t_{PHZ}$ |                                                            | 6     |     | 9   |              | 6   | 9   | ns   |

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.

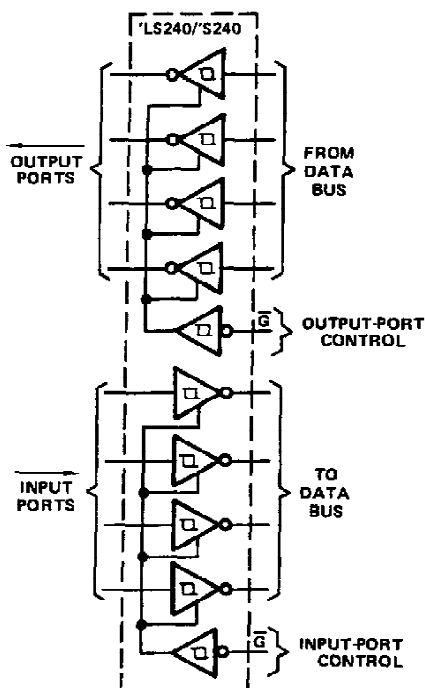
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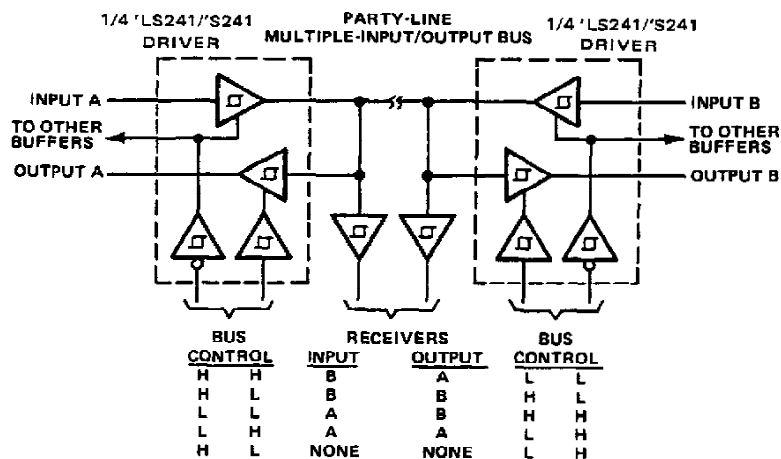
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SN74LS240, SN74LS241, SN74LS244, SN74S240, SN74S241, SN74S244  
OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS**



'LS240/'S240 USED AS SYSTEM AND/OR MEMORY BUS DRIVER—4-BIT ORGANIZATION CAN BE APPLIED TO HANDLE BINARY OR BCD



INDEPENDENT 4-BIT BUS DRIVERS/RECEIVERS IN A SINGLE PACKAGE



PARTY-LINE BUS SYSTEM WITH MULTIPLE INPUTS, OUTPUTS, AND RECEIVERS

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